

Amendments to the Claims:

This listing of claims replaces all prior versions and listings of claims in the application:

Listing of Claims:

1. (Currently Amended) A signal processing apparatus comprising:
an input to receive a signal, wherein the signal from the input comprises an analog signal;
an analog-to-digital converter (ADC) to convert the analog signal to a digital signal;
a buffer responsive to the ~~input~~ ADC to store the digital signal;
a filter in communication with the ADC to produce a filtered digital signal based on the
digital signal;
a detector responsive to the ~~input~~ filter to interpret the filtered digital signal as discrete values;
an averaging circuit ~~responsive to~~ in communication with the buffer and the detector to cause interpretation, by the detector during a retry mode, of a new signal comprising an average ~~of a~~ that is determined responsive to a group of signals, the group of signals comprising one or more previous signals stored in the buffer and a current signal;
a control circuit that determines whether the discrete values are adequately indicated based on output of the detector, that initiates the retry mode when the discrete values are not adequately indicated, and that determines whether the discrete values are adequately indicated from the interpretation of the new signal in the retry mode; and
an error correction circuit ~~responsive to~~ in communication with the detector and the averaging circuit to provide a signal quality metric ~~that governs which signals are averaged~~ that is based on output of the detector, wherein the control circuit uses the signal quality metric to include a signal of the group of signals in the average or exclude a signal of the group of signals from the average.

2. (Previously presented) The apparatus of claim 1, wherein the signal from the input comprises a read signal received from a storage medium.

3. (Cancelled)

4. (Currently Amended) The apparatus of claim [[3]] 1, wherein the buffer is coupled between the ADC and the filter.

5. (Currently Amended) The apparatus of claim [[3]] 1, wherein the buffer is coupled between the filter and the detector.

6. (Currently Amended) The apparatus of claim [[3]] 1, wherein the filter comprises a finite impulse response (FIR) digital filter ~~coupled between the ADC and the detector~~.

7. (Cancelled)

8. (Original) The apparatus of claim 1, wherein the detector comprises a Viterbi detector.

9. (Currently Amended) A signal processing apparatus, comprising:
an input to receive a signal, wherein the signal from the input comprises an analog signal;
an analog-to-digital converter (ADC) to convert the analog signal to a digital signal;
a buffer responsive to the ~~input~~ ADC to store the digital signal;
a filter in communication with the ADC to produce a filtered digital signal based on the digital signal;

a detector responsive to the ~~input~~ filter to interpret the filtered digital signal as discrete values;

an averaging circuit ~~responsive to~~ in communication with the buffer and the detector to cause interpretation, by the detector during a retry mode, of ~~a new~~ an averaged signal comprising ~~an~~ a weighted average of [[a]] one or more previous signals stored in the buffer and a current

signal; and

a control circuit that determines whether the discrete values are adequately indicated based on output of the detector, that initiates the retry mode when the discrete values are not adequately indicated, and that determines whether the discrete values are adequately indicated from the interpretation of the ~~new~~ averaged signal in the retry mode₁[[;]]

wherein the control circuit determines whether the discrete values are adequately indicated based on comparison of interpretations of the ~~new~~ averaged signal and the current signal₁

wherein the averaging circuit determines the weighted average based on weights respectively associated with the one or more previous signals and the current signal, wherein the weights are based on respective signal quality measures, and wherein the signal quality measures are based on output of the detector.

10. (Previously presented) The apparatus of claim 9, wherein the control circuit causes averaging of a defined number of most recent input signals, wherein the defined number is greater than two.

11. (Cancelled)

12. (Currently Amended) A storage device, comprising:
a storage medium;
a head assembly operable to generate an analog read signal from the storage medium;
an analog-to-digital converter (ADC) to convert the analog read signal to a digital read signal;
a buffer that saves the digital read signal ~~generated by the head assembly;~~
a filter in communication with the ADC to produce a filtered digital read signal based on the digital read signal;
a detector that interprets the filtered digital read signal as discrete values;
an averaging circuit ~~responsive to~~ in communication with the buffer and the detector;

a control circuit ~~responsive to~~ in communication with the averaging circuit to determine whether the discrete values are adequately indicated based on output of the detector, initiate a retry mode when the discrete values are not adequately indicated, cause interpretation by the detector in the retry mode of a new read signal comprising an average ~~of a~~ that is determined responsive to a group of signals, the group of signals comprising one or more previous signals stored in the buffer and a current read signal, and determine whether the discrete values are adequately indicated from the interpretation of the new read signal in the retry mode; and

an error correction circuit ~~responsive to~~ in communication with the detector and the averaging circuit to provide a signal quality metric ~~that governs which signals are averaged~~ that is based on output of the detector, wherein the control circuit uses the signal quality metric to include a signal of the group of signals in the average or exclude a signal of the group of signals from the average.

13. (Cancelled)

14. (Currently Amended) The storage device of claim [[13]] 12, wherein the buffer is coupled between the ADC and the filter.

15. (Currently Amended) The storage device of claim [[13]] 12, wherein the buffer is coupled between the filter and the detector.

16. (Currently Amended) The storage device of claim [[13]] 12, wherein the filter comprises a finite impulse response (FIR) digital filter ~~coupled between the ADC and the detector.~~

17. (Cancelled)

18. (Previously presented) The storage device of claim 12, wherein the detector comprises a Viterbi detector.

19. (Currently Amended) A storage device, comprising:
a storage medium;
a head assembly operable to generate an analog read signal from the storage medium;
an analog-to-digital converter (ADC) to convert the analog read signal to a digital read signal;
a buffer that saves the digital read signal ~~generated by the head assembly;~~
a filter in communication with the ADC to produce a filtered digital read signal based on the digital read signal;
a detector that interprets the filtered digital read signal as discrete values;
an averaging circuit ~~responsive to~~ in communication with the buffer and the detector; and
a control circuit ~~responsive to~~ in communication with the averaging circuit to determine whether the discrete values are adequately indicated based on output of the detector, initiate a retry mode when the discrete values are not adequately indicated, cause interpretation by the detector in the retry mode of ~~a new~~ an averaged read signal comprising ~~an~~ a weighted average of ~~one or more~~ one or more previous read signals stored in the buffer and a current read signal, and determine whether the discrete values are adequately indicated from the interpretation of the ~~new averaged~~ averaged signal in the retry mode, ~~wherein the averaging circuit determines the weighted average based on weights respectively associated with the one or more previous signals and the current signal, wherein the weights are based on respective signal quality measures, and wherein the signal quality measures are based on output of the detector. wherein the control circuit determines whether the discrete values are adequately indicated based on comparison of interpretations of the new averaged read signal and the current read signal.~~

20. (Previously presented) The storage device of claim 19, wherein the control circuit causes averaging of a defined number of most recent read signals, wherein the defined number is greater than two.

21. (Cancelled)

22. (Currently Amended) A method of reading data on a channel or media, the method comprising:

interpreting an input signal as discrete values;

deciding whether the discrete values have been adequately interpreted from the input signal;

entering a retry mode in response to a decision that the discrete values have not been adequately interpreted from the input signal; ~~and~~

obtaining, in the retry mode, second signals representing same data as the input signal;

obtaining signal quality metrics corresponding to the second signals and the input signal;

averaging, in the retry mode, multiple signals to produce an averaged signal to improve interpretation of the input signal, the multiple signals including at least two or more of the input signal and the second signals, wherein the averaging comprises using the signal quality metrics to include a respective signal in the averaged signal or exclude the respective signal from the averaged signal; ~~including: obtaining second signal representing same data as the input signal, averaging the input signal and the second signal to produce an averaged signal and to improve signal interpretation,~~

interpreting the averaged signal as new discrete values; [[,]] and

determining whether the new discrete values are adequately indicated, ~~based on the averaged signal; wherein interpreting the input signal comprises using maximum likelihood detection and error correction to provide the discrete values and a signal quality metric, the method further comprising excluding the input signal from the multiple signals to be averaged based on the signal quality metric.~~

23. (Original) The method of claim 22, wherein interpreting the input signal comprises:

sampling the input signal;

storing the sampled input signal; and
detecting the discrete values in the sampled input signal.

24. (Original) The method of claim 23, wherein sampling the input signal comprises converting the input signal to a digital signal, storing the sampled input signal comprises storing the digital signal, and the multiple signals to be averaged include the stored digital signal.

25. (Original) The method of claim 23, wherein sampling the input signal comprises converting the input signal to a digital signal and filtering the digital signal based on finite impulse response, storing the sampled input signal comprises storing the filtered digital signal, and the multiple signals to be averaged include the stored and filtered digital signal.

26. (Original) The method of claim 22, wherein the input signal comprises a read signal received from a storage medium, interpreting the input signal comprises determining if the read signal adequately indicates the discrete values, and averaging the multiple signals comprises averaging multiple read signals of the storage medium to improve read signal interpretation.

27.-28. (Cancelled)

29. (Previously presented) The method of claim 22, wherein determining whether the discrete values are adequately indicated comprises interpreting the averaged signal with a Viterbi detector.

30. (Currently Amended) A method of reading data on a channel or media, the method comprising:

interpreting an input signal as discrete values;
deciding whether the discrete values have been adequately interpreted from the input signal;
entering a retry mode in response to a decision that the discrete values have not been adequately interpreted from the input signal; ~~and~~

obtaining, in the retry mode, one or more second signals representing same data as the input signal;

averaging, in the retry mode, multiple signals to improve interpretation of the input signal, wherein the averaging includes including: obtaining a second signal representing same data as the input signal, averaging determining a weighted average based on weights, the input signal, and the one or more second signals to produce an averaged signal and to improve signal interpretation, wherein the weights correspond, respectively, to the input signal and the one or more second signals, wherein the weights are based on respective signal quality measures;

interpreting the averaged signal as new discrete values; [[,]] and

determining whether the new discrete values are adequately indicated, ~~based on the averaged signal;~~ wherein determining whether the new discrete values are adequately indicated comprises comparing interpretations of the averaged signal and of the one or more second signals.

31. (Previously presented) The method of claim 30, wherein averaging the multiple signals further comprises, in the retry mode, in response to the discrete values being inadequately indicated, repeatedly obtaining a new signal, averaging most recent signals to generate a newly averaged signal, and determining if the newly averaged signal adequately indicates the discrete values.

32. (Original) The method of claim 31, wherein averaging the most recent signals comprises averaging the three most recent signals.

33. (Previously presented) The method of claim 22, wherein averaging the multiple signals further comprises, in the retry mode, in response to the discrete values being inadequately indicated, repeatedly obtaining a new signal, averaging the new signal with the previous averaged signal, and determining if the newly averaged signal adequately indicates the discrete values.

34. (Currently Amended) A system comprising:
means for storing data; and
means for reading the data, said means for reading including:
means for interpreting an input signal as discrete values;
means for deciding whether the discrete values have been adequately interpreted from the input signal;
means for entering a retry mode in response to a decision that the discrete values have not been adequately interpreted from the input signal; and
means for averaging, in the retry mode, multiple read signals to produce an averaged signal to improve signal interpretation, the means for averaging including:
means for obtaining ~~[[a]]~~ second signals representing same data as the input signal, the multiple read signals including at least two or more of: the input signal and the second signals,
means for obtaining signal quality metrics corresponding to the second signals and the input signal,
~~means for averaging the input signal and the second signal to produce an averaged signal and to improve signal interpretation,~~
means for using the signal quality metrics to include a respective signal in the averaged signal or exclude the respective signal from the averaged signal;
means for interpreting the averaged signal as new discrete values, and
means for determining whether the new discrete values are adequately indicated ~~based on the averaged signal;~~
wherein the means for reading further includes error-detection means for controlling which read signals are averaged.

35. (Original) The system of claim 34, wherein the means for storing data comprises magnetic means for storing data.

36. (Original) The system of claim 34, wherein the means for averaging comprises means for saving a digital read signal before equalization in a read channel.

37. (Original) The system of claim 36, wherein the means for saving a digital read signal comprises means for saving an averaged read signal.

38. (Original) The system of claim 34, wherein the means for reading further includes means for converting the read signals to digital signals, means for filtering the digital signals, and means for detecting stored information in the filtered digital signals.

39. (Original) The system of claim 38, wherein the means for averaging comprises means for storing a read signal between the means for converting and the means for filtering.

40. (Original) The system of claim 38, wherein the means for averaging comprises means for storing a read signal between the means for filtering and the means for detecting.

41. (Original) The system of claim 38, wherein the means for detecting comprises Viterbi means for detecting stored information in the filtered digital signals.

42. (Cancelled)

43. (Currently Amended) A system comprising:
means for storing data; and
means for reading the data, said means for reading including:
means for interpreting an input signal as discrete values;
means for deciding whether the discrete values have been adequately interpreted from the input signal;
means for entering a retry mode in response to a decision that the discrete values have not been adequately interpreted from the input signal; and
means for averaging, in the retry mode, multiple read signals to produce an averaged

signal to improve signal interpretation, the means for averaging including:

means for obtaining [[a]] one or more second signals representing same data as the input signal,

means for determining a weighted average based on weights, the input signal, and the one or more second signals to produce an averaged signal, wherein the weights correspond, respectively, to the input signal and the one or more second signals, wherein the weights are based on respective signal quality measures;

~~means for averaging the input signal and the second signal to produce an averaged signal and to improve signal interpretation;~~

means for interpreting the averaged signal as new discrete values, and

means for determining whether the new discrete values are adequately indicated ~~based on the averaged signal;~~

wherein the means for reading further includes means for comparing an averaged read signal and a current read signal.

44. (Previously presented) The system of claim 43, wherein the means for averaging comprises means for averaging three or more most recent read signals.

45. (Currently Amended) An article comprising:

means for interpreting an input signal as discrete values;

means for deciding whether the discrete values have been adequately interpreted from the input signal;

means for entering a retry mode in response to a decision that the discrete values have not been adequately interpreted from the input signal; and

means for averaging, in the retry mode, multiple read signals to produce an averaged signal to improve signal interpretation, the means for averaging including:

means for obtaining [[a]] second signals representing same data as the input signal, the multiple read signals including at least two or more of: the input signal and the second signals,

means for obtaining signal quality metrics corresponding to the second signals and the

input signal,

~~means for averaging the input signal and the second signal to produce an averaged signal and to improve signal interpretation;~~

means for using the signal quality metrics to include a respective signal in the averaged signal or exclude the respective signal from the averaged signal;

means for interpreting the averaged signal as new discrete values, and

means for determining whether the discrete values are adequately indicated, ~~based on the averaged signal; wherein the means for interpreting comprises maximum likelihood detection and error correction means for providing the discrete values and a signal quality metric used to exclude an input signal from averaging.~~

46. (Currently Amended) The article of claim 45, wherein the means for interpreting the input signal comprises:

means for sampling the input signal;

means for storing the sampled input signal; and

means for detecting the discrete values in the sampled input signal.

47. (Original) The article of claim 46, wherein the means for sampling comprises means for converting the input signal to a digital signal, and the means for storing comprises means for storing the digital signal, and the means for averaging comprises means for averaging the stored digital signal and a current signal.

48. (Original) The article of claim 46, wherein the means for sampling comprises means for converting the input signal to a digital signal and means for filtering the digital signal based on finite impulse response, and the means for storing comprises means for storing the filtered digital signal, and the means for averaging comprises means for averaging the stored and filtered digital signal and a current signal.

49.-50. (Cancelled)

51. (Previously presented) The article of claim 45, wherein the means for determining comprises Viterbi means for interpreting the averaged signal.

52. (Currently Amended) An article comprising:
means for interpreting an input signal as discrete values;
means for deciding whether the discrete values have been adequately interpreted from the input signal;
means for entering a retry mode in response to a decision that the discrete values have not been adequately interpreted from the input signal; and
means for averaging, in the retry mode, multiple read signals to produce an averaged signal to improve signal interpretation, the means for averaging including:
means for obtaining [[a]] one or more second signals representing same data as the input signal,
means for determining a weighted average based on weights, the input signal, and the one or more second signals to produce an averaged signal, wherein the weights correspond, respectively, to the input signal and the one or more second signals, wherein the weights are based on respective signal quality measures;
~~means for averaging the input signal and the second signal to produce an averaged signal and to improve signal interpretation;~~
means for interpreting the averaged signal as new discrete values, and
means for determining whether the new discrete values are adequately indicated, ~~based on the averaged signal;~~ wherein the means for determining comprises means for comparing interpretations of the averaged signal and of the second signal.

53. (Currently Amended) An apparatus comprising:
means for receiving a signal, wherein the signal comprises an analog signal;
means for converting the analog signal to a digital signal;
means for storing the digital signal;
means for filtering the digital signal;

means for interpreting the filtered digital signal as discrete values;

retry-mode means for interpreting a new signal comprising an average that is determined responsive to a group of signals, the group of signals comprising one or more ~~[[a]]~~ stored signals and a current signal;

means for determining whether the discrete values are adequately indicated based on output of the means for interpreting, initiating the retry-mode means when the discrete values are not adequately indicated, and determining whether the discrete values are adequately indicated from the interpretation of the new signal by the retry-mode means; ~~and~~

means for providing a signal quality metric that governs which signals are averaged; and means for using the signal quality metric to include a corresponding signal in the average or exclude the corresponding signal from the average.

54. (Original) The apparatus of claim 53, wherein the means for receiving comprises means for receiving a read signal from a storage medium.

55. (Cancelled)

56. (Currently Amended) The apparatus of claim ~~[[55]]~~ 53, wherein the means for storing comprises means for buffering the digital signal.

57. (Currently Amended) The apparatus of claim ~~[[55]]~~ 53, wherein the means for storing comprises means for buffering the filtered digital signal.

58. (Currently Amended) The apparatus of claim ~~[[55]]~~ 53, wherein the means for filtering comprises a finite impulse response (FIR) digital filter.

59. (Cancelled)

60. (Original) The apparatus of claim 53, wherein the retry-mode means for interpreting comprises a Viterbi detector.

61. (Currently Amended) An apparatus comprising:
means for receiving a signal, wherein the signal comprises an analog signal;
means for converting the analog signal to a digital signal;
means for filtering the digital signal;
means for interpreting the filtered digital signal as discrete values;
retry-mode means for interpreting ~~a new signal comprising~~ an averaged signal that is
based on a weighted average of one or more [[a]] stored signals and a current signal, wherein the
weighted average is determined based on weights respectively associated with the one or more
stored signals and the current signal, wherein the weights are based on respective signal quality
measures; and
means for determining whether the discrete values are adequately indicated based on
output of the means for interpreting, initiating the retry-mode means when the discrete values are
not adequately indicated, and determining whether the discrete values are adequately indicated
from the interpretation of the ~~new~~ averaged signal by the retry-mode means;
wherein the means for determining comprises means for determining whether the discrete
values are adequately indicated based on comparison of interpretations of the averaged signal
and the current signal.

62. (Previously presented) The apparatus of claim 61, further comprising means for
averaging a defined number of most recent input signals, wherein the defined number is greater
than two.

63. (Original) The apparatus of claim 53, further comprising means for causing the
stored signal to be an averaged input signal when two or more signals are obtained in a retry
mode.

64. (Currently Amended) A machine-readable medium embodying information
indicative of instructions for causing one or more machines to perform operations for reading
data on a channel or media, the operations comprising:

interpreting an input signal as discrete values;
deciding whether the discrete values have been adequately interpreted from the input signal;
entering a retry mode in response to a decision that the discrete values have not been adequately interpreted from the input signal; and
obtaining, in the retry mode, second signals representing same data as the input signal;
obtaining signal quality metrics corresponding to the second signals and the input signal;
averaging, in the retry mode, multiple signals to produce an averaged signal to improve interpretation of the input signal, the multiple signals including at least two or more of the input signal and the second signals, wherein the averaging comprises using the signal quality metrics to include a respective signal in the averaged signal or exclude the respective signal from the averaged signal; ~~including: obtaining a second signal representing same data as the input signal, averaging the input signal and the second signal to produce an averaged signal and to improve signal interpretation;~~
interpreting the averaged signal as new discrete values; [[,]] and
determining whether the new discrete values are adequately indicated, ~~based on the averaged signal; wherein interpreting the input signal comprises using maximum likelihood detection and error correction to provide the discrete values and a signal quality metric, and the operations further comprise excluding the input signal from the multiple signals to be averaged based on the signal quality metric.~~

65. (Original) The machine-readable medium of claim 64, wherein interpreting the input signal comprises:

sampling the input signal;
storing the sampled input signal; and
detecting the discrete values in the sampled input signal.

66. (Original) The machine-readable medium of claim 65, wherein sampling the input signal comprises converting the input signal to a digital signal, storing the sampled input signal

comprises storing the digital signal, and the multiple signals to be averaged include the stored digital signal.

67. (Original) The machine-readable medium of claim 65, wherein sampling the input signal comprises converting the input signal to a digital signal and filtering the digital signal based on finite impulse response, storing the sampled input signal comprises storing the filtered digital signal, and the multiple signals to be averaged include the stored and filtered digital signal.

68. (Original) The machine-readable medium of claim 64, wherein the input signal comprises a read signal received from a storage medium, interpreting the input signal comprises determining if the read signal adequately indicates the discrete values, and averaging the multiple signals comprises averaging multiple read signals of the storage medium to improve read signal interpretation.

69.-70. (Cancelled)

71. (Previously presented) The machine-readable medium of claim 64, wherein determining whether the discrete values are adequately indicated comprises interpreting the averaged signal with a Viterbi detector.

72. (Currently Amended) A machine-readable medium embodying information indicative of instructions for causing one or more machines to perform operations for reading data on a channel or media, the operations comprising:

interpreting an input signal as discrete values;

deciding whether the discrete values have been adequately interpreted from the input signal;

entering a retry mode in response to a decision that the discrete values have not been adequately interpreted from the input signal; ~~and~~

obtaining, in the retry mode, one or more second signals representing same data as the

input signal;

averaging, in the retry mode, multiple signals to improve interpretation of the input signal, ~~wherein the averaging includes including: obtaining a second signal representing same data as the input signal, averaging~~ determining a weighted average based on weights, the input signal, and the one or more second signals to produce an averaged signal and to improve signal interpretation, ~~wherein the weights correspond, respectively, to the input signal and the one or more second signals, wherein the weights are based on respective signal quality measures;~~

interpreting the averaged signal as new discrete values; [[,]] and

determining whether the new discrete values are adequately indicated based on the averaged signal;

wherein determining whether the new discrete values are adequately indicated comprises comparing interpretations of the averaged signal and of the one or more second signals.

73. (Previously presented) The machine-readable medium of claim 72, wherein averaging the multiple signals further comprises, in the retry mode, in response to the discrete values being inadequately indicated, repeatedly obtaining a new signal, averaging most recent signals, and determining if the newly averaged signal adequately indicates the discrete values.

74. (Original) The machine-readable medium of claim 73, wherein averaging the most recent signals comprises averaging the three most recent signals.

75. (Previously presented) The machine-readable medium of claim 64, wherein averaging the multiple signals further comprises, in the retry mode, in response to the discrete values being inadequately indicated, repeatedly obtaining a new signal, averaging the new signal with the previous averaged signal, and determining if the newly averaged signal adequately indicates the discrete values.

76. (Previously presented) The article of claim 52, wherein the means for averaging the multiple signals further comprise means for, in the retry mode, in response to the discrete values being inadequately indicated, repeatedly obtaining a new signal, averaging most recent

signals to generate a newly averaged signal, and determining if the newly averaged signal adequately indicates the discrete values.

77. (Previously presented) The article of claim 76, wherein the means for averaging the most recent signals comprises means for averaging the three most recent signals.

78. (Previously presented) The article of claim 45, wherein the means for averaging the multiple signals further comprise means for, in the retry mode, in response to the discrete values being inadequately indicated, repeatedly obtaining a new signal, averaging the new signal with the previous averaged signal, and determining if the newly averaged signal adequately indicates the discrete values.

79. (New) The apparatus of claim 9, wherein the buffer is coupled between the ADC and the filter.

80. (New) The apparatus of claim 9, wherein the buffer is coupled between the filter and the detector.

81. (New) The storage device of claim 19, wherein the buffer is coupled between the ADC and the filter.

82. (New) The storage device of claim 19, wherein the buffer is coupled between the filter and the detector.